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# (54) Fluidic devices

(57) A fluid device comprising a plurality of vortex diodes 5 arranged in series such that the axial port 7 of each diode in the series communicates with the tangential port 6 of the next succeeding diode in the series. In a high resistance mode of operation, flow enters the tangential port 6 of the first diode in the series via inlet port 8 and passage 9 and exits through the axial port of the last diode in the series via outlet 10. A small outlet flow can be achieved by the series connection and using a plurality of large individual vortex diodes to thereby reduce the possibility of blockage by sediment in the flow.

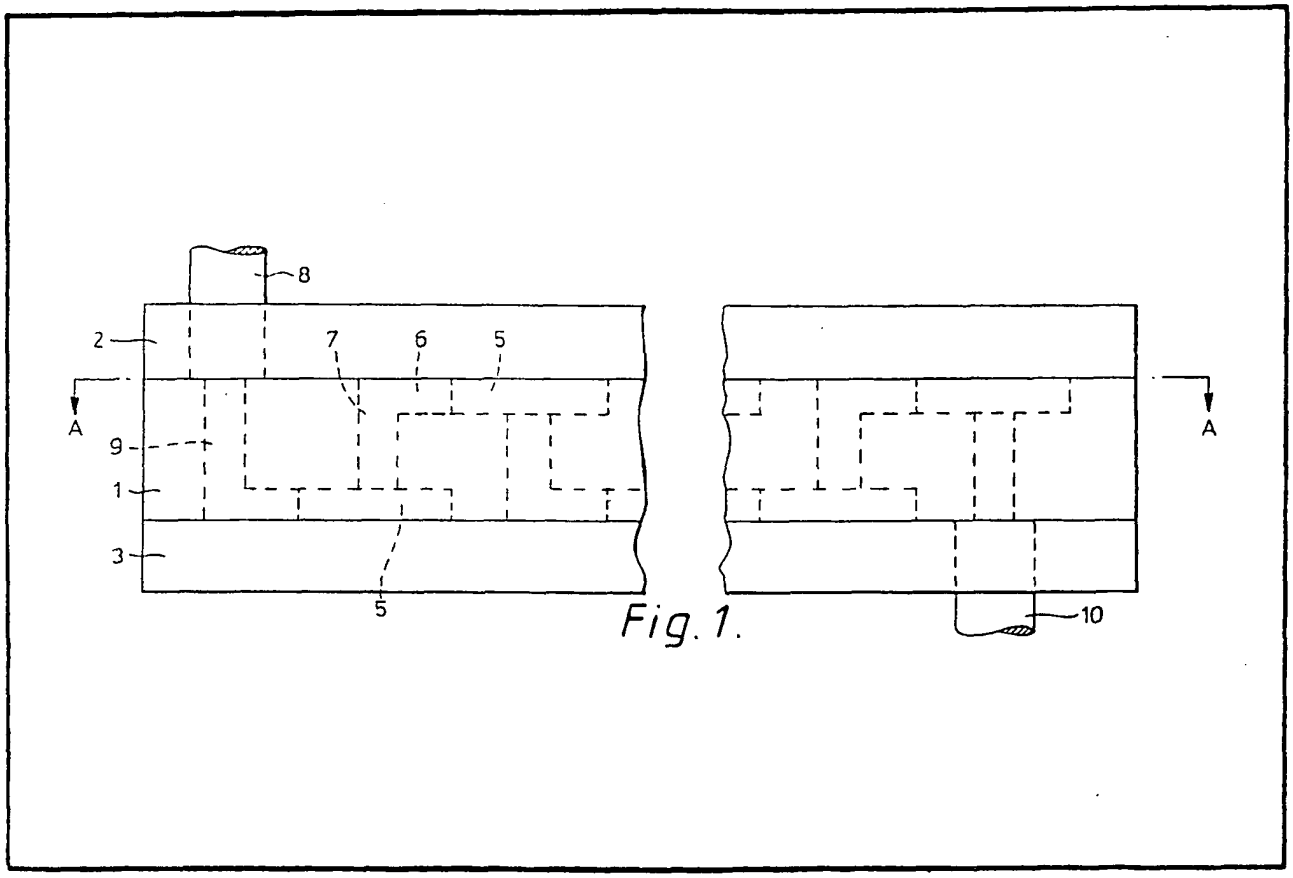


Fig. 1.

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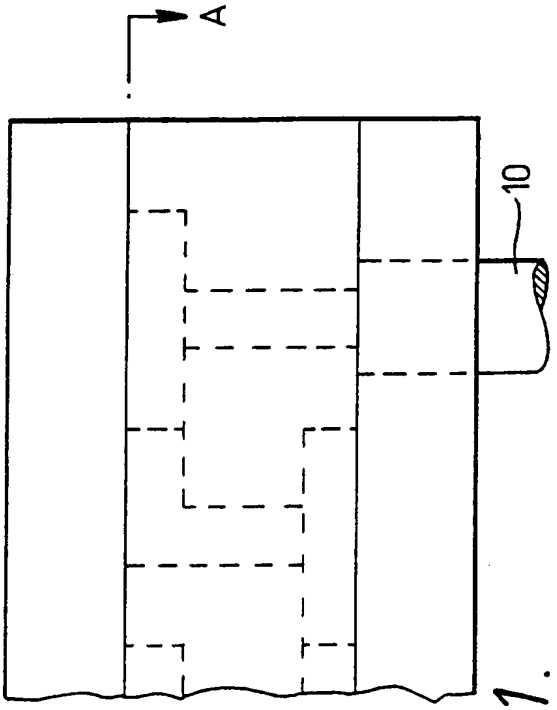
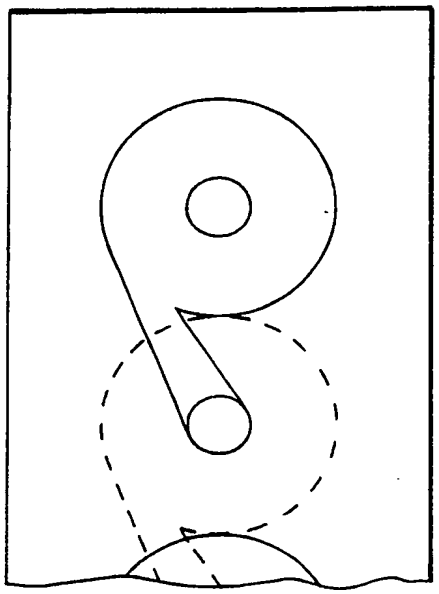
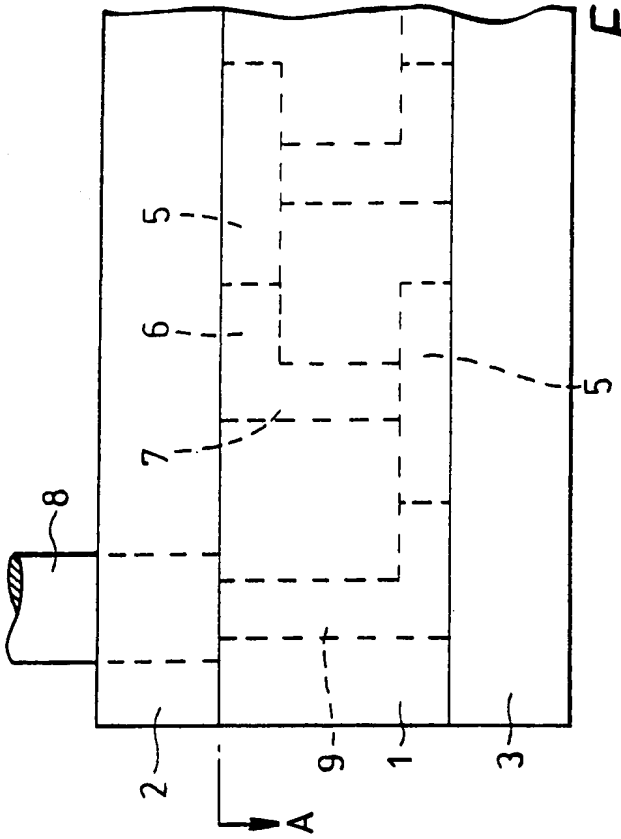



Fig. 1.





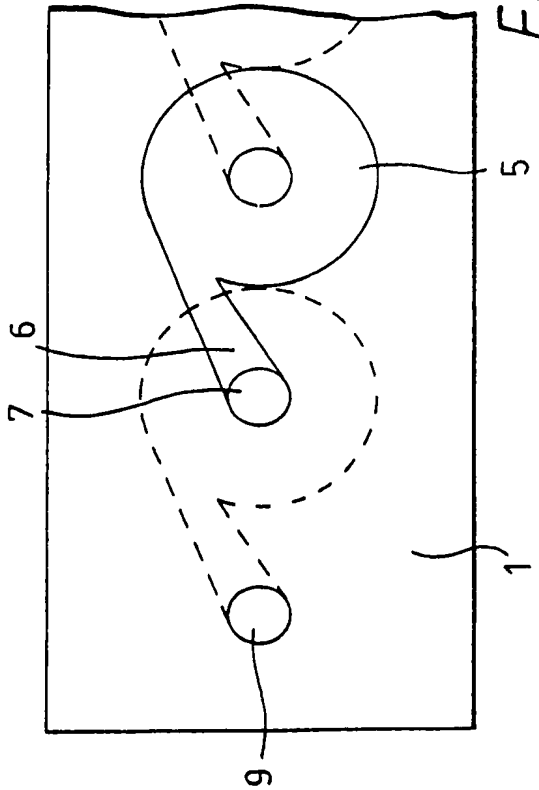




Fig. 2.

SPECIFICATION

**Improvements in and relating to fluidic devices**

The present invention concerns fluidic devices, in particular fluidic diodes.

Fluidic diodes are devices which have a high resistance to fluid flow therethrough in one direction and a low resistance to the flow in the opposite direction. One form of fluidic diode is that known as a vortex diode which comprises a cylindrical vortex chamber having a tangential port and an axial port. Flow entering the chamber the chamber through the tangential port creates a vortex before leaving through the axial port. The centrifugal reaction of this vortex sets up a pressure difference between the two ports which opposes the flow. The flow is thus in the high resistance direction. Flow in the opposite direction from the axial port to the tangential port does not set up a vortex in the chamber. This flow is in the low resistance direction.

A vortex diode can be used to throttle or reduce flow when inserted in a fluid flow line with the flow therethrough in the high resistance direction. The vortex diode can therefore be used to bleed a sample from a flow line, for example, for monitoring and quality control purposes. However for small sample outlet flow the required size of vortex diode can be prone to blockage by sediment in the flow.

To avoid this problem of blockage it is proposed, according to the present invention, to employ a fluidic device for sampling or metering a flow stream which comprises a plurality of vortex diodes connected together in series or cascade such that the axial port of each diode is connected to the tangential port of the next succeeding diode in the series whereby in the high resistance direction flow enters the tangential port of the first diode of the series and exits through the axial port of the last diode in the series.

As a result of the series or cascade connection of the diodes it is possible to utilise relatively large individual diodes which are less prone to blockage by sediment or suspended solids in the flow. The dimensions of the diodes are determined by the condition of the fluid, that is the dimensions of the ports and chambers are chosen so as to avoid blockage during use. Having determined the dimensions of the diodes the number of diodes in the series is selected to provide a required outflow from the axial port of the last diode in the series.

The invention will be described, by way of example, with reference to the accompanying drawings in which:

Fig. 1 is a diagrammatic elevation of a fluidic device comprising a plurability of vortex diodes, shown in phantom, connected in series or cascade; and

Fig. 2 is a plan view on line A—A in Fig. 1.

A multi-stage fluidic diode assembly comprises an elongate central block 1 located between upper and lower plates 2 and 3, the plates 2 and 3 being clamped to the opposite faces of the block 1 by nut and bolt assembles (not shown) which are received in aligned bores (not shown) in the block and the plates.

Individual vortex diodes, each comprising a vortex chamber 5, a tangential port 6 and an axial port 7 are formed at opposite face of the block 1, the chambers at opposite faces of the block being staggered as shown in Fig. 2 where the full outline profiles depict the chambers and ports at the upper face of the block and the dotted outline profiles depict the chambers and ports at the opposite lower face.

The block 1 can be stainless steel and the chambers 5 and tangential ports 6 can be milled out of the opposite faces of the block. The axial ports 7 can be formed by drilling. The plates 2 and 3 complete the chambers and ports and are in fluid tight abutment against the faces of the block 1.

An inlet conduit 8 secured to the plate 2 communicates with drilling 9 in the block 1 and drilling 9 communicates with the tangential port of the first vortex diode of the series at the opposite face of the block. The axial outlet of this first vortex diode in turn leads to the tangential port of the next following vortex diode which is located in the upper face of the block 1. The series or cascade connection of the diodes proceeds in like manner to the last diode at which the axial outlet communicates with an outlet conduit 10 in the plate 3. Thus inlet flow at the conduit 8 proceeds through the vortex diodes to exit at the conduit 10 and the diodes are arranged so as to constitute a flow restrictor. The number of diodes in the series is chosen to give a required restricted flow at the outlet 10 and the diodes and ports are dimensioned to suit the condition of the fluid so as to avoid blockage by sediment or suspended solids in the flow.

It will be appreciated that the series or cascade connection can be achieved by arrangements other than the in-line configuration shown in the drawings. Other diode arrangements and configurations are possible to achieve the desired series or cascade connection.

**Claims** (Filed on 11 Oct 82)

1. A fluidic device comprising a plurality of vortex diodes, each diode comprising a vortex chamber having a tangential port and an axial port, the vortex diodes being arranged in series or cascade such that the axial port of each diode communicates with the tangential port of the next succeeding diode in the series whereby in the high resistance direction flow enters the tangential port of the first diode in the series and exits through the axial port of the last diode in the series.

2. A fluidic device as claimed in claim 1 in which the vortex diodes are arranged in an in-line staggered configuration.

3. A fluidic device comprising a plurality of vortex diodes constructed, arranged and adapted to operate substantially as herein described with reference to and as illustrated in the accompanying drawings.

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